

# EXOBIOLICAL IMPLICATIONS OF DUST AGGREGATION IN PLANETARY ATMOSPHERES: AN EXPERIMENT FOR THE GAS-GRAIN SIMULATION FACILITY

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Processes involving small particles (micrometer to centimeter in size) are important to the understanding of a wide diversity of phenomena. Among them is the tendency for very fine particles (dust) to aggregate into clusters as a result of surface electrostatic charging and van der Waals forces, for example. Clustering or aggregation of materials has played an important role in the origin and evolution of life. Within our own solar system, this aggregation process influenced the rate and mode of formation of the solar system bodies themselves; it has continued to influence life by controlling the rate at which planetary atmospheres are cleansed of dust falls.

Aggregation of fine particles has been extensively modeled by mathematical analysis and computer simulations, but the study of such phenomena in the terrestrial laboratory is virtually impossible due to the fact that aggregation causes rapid sedimentation of materials to the bottom of the experimental chamber; there is insufficient time for aggregates to fully develop, and there is insufficient time for studying their behavior. This problem can be overcome by conducting experiments in microgravity where protracted suspension times can be achieved. The Gas-Grain Simulation Facility (GGSF) will provide such a microgravity environment where undesirable environmental effects are reduced, and thus, experiments involving interactions between small particles and grains can be more suitably performed.

The GGSF will occupy a Space Station double rack and consist of a number of subsystems supporting an experiment chamber. The subsystems will provide environmental control (to regulate temperature, pressure, humidity, etc.), mechanisms for injecting and removing particles and clouds of particles, levitation systems, shock mounts and other vibration-isolating systems, energy sources, and a number of experiment monitoring and measuring devices. A number of experiments spanning a range of disciplines have been proposed for performance in the GGSF which will be flown in several phases until the year 2000 when it will be a fully independent module onboard Space Station Freedom.

The earliest flight opportunity is the ESA glovebox facility onboard Shuttle. Slated for flight in 1992, this glovebox will serve as a scientific and technological testbed for GGSF exobiology experiments as well as generating some basic scientific data. Initial glovebox experiments will test a method of generating a stable, mono-dispersed cloud of fine particles using a vibrating sprinkler system. In the absence of gravity and atmospheric turbulence, it will be possible to determine the influence of interparticle forces in controlling the rate and mode of aggregation. The experimental chamber can be purged of suspended material to enable multiple repetitions of the experiments. Of particular interest will be the number of particles per unit volume of the chamber because it is suspected that aggregation will occur extremely rapidly if the number exceeds a critical value. All aggregation events will be recorded on high-resolution video film. Changes in the experimental procedure as a result of surprise events will be accommodated by real-time interaction with the mission specialist during the Shuttle flight.